

SERVICE MANUAL

Series 500 Display Unit

1-714-540-1301

MP MASTER



MA32031

Manufactured by:
IKL INCORPORATED
NEWPORT BEACH, CALIF.



IKL INCORPORATED

MODEL 500 DISPLAY UNIT

INTRODUCTION

The Model 500 Display Unit provides a continuous visual numeric display of position information for a variety of measuring equipment, including digital micrometers, manually and automatically controlled machines, and special measuring machines. Depending upon the specific application, the display may be single or dual axis, single axis with front panel input switches or dual axis with remote input switches. In addition, a special English/Metric conversion capability may be added with the ability to read out in either English or Metric units as selected by a rear panel switch.

The transducer senses both the direction and the amount of the axis being monitored. This is accomplished by a rotary photoelectric incremental encoder coupled to a lead screw, shaft, rack and pinion, or other machine elements to sense translation or rotation of the machine member. The amount of encoder rotation is proportional to the machine axis travel and direction of rotation indicates the direction of axis motion. The encoder converts the information to digital electrical signals which are processed and displayed as a decimal number in the Display Unit.

MODEL 500 DISPLAY UNIT OPERATION

General

The Display Unit consists of three basic elements packaged in a cabinet. These elements are 1) a multiple decade bi-directional electronic counter, 2) a numerical indicator tube readout of counter information, and 3) a power supply to furnish low voltage power for the electronic counter and the transducer encoder, and high voltage power for the display tubes. Readout for one or two monitored axes is placed in one cabinet.

The reset switch, used for zeroing the display, is located on the front panel. Rear panel controls include the power switch, direction control switch, blanking control switch, and optional English/Metric selection switch.

The Display Unit is constructed in modular form using printed circuit cards. The electronic circuitry and display tubes for one complete axis of readout are mounted upon one card. The power supply is mounted to the removable rear panel. Axis display cards plug into receptacles on the power supply P.C. card and slide into slots on the inside front edges of the housing. The cards are removed from the rear; the front panel is not normally removed.

Counter and Display Circuits

The circuits for monitoring one axis consist of the following functional elements: 1) Quadrature detection circuits, 2) Polarity control logic, 3) Bi-directional decade counters, 4) Display tube driver circuits, and 5) Numerical display tubes. The circuitry is comprised of silicon integrated circuits, and all circuits and tubes for one axis are mounted on one card.

The quadrature square wave signals from the transducer encoder are detected by the Quadrature Detection Circuits, which generate clockwise (CW) and counterclockwise (CCW) pulses depending upon the direction of travel of the encoder. The Quadrature Detection Circuits develop four count pulses for each quadrature input cycle. The count factor may be varied by means of jumper wires to select either 1, 2, or 4 pulses per input cycle in order to match up the display resolution to the encoder resolution. The rear panel direction switch allows selection of direction by interchanging the pulse lines which are routed to the Polarity Control Logic.

The Polarity Control Logic determines the polarity sign and whether the counters are to be counting UP or DOWN. The



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Polarity Control Logic senses the output of the counter stages for the conditions when the counter is at ZERO.

The Bi-directional Decade Counter stages are driven by the UP and DOWN pulse outputs from the Polarity Control Logic. The output of each stage drives the input of the succeeding stage. Sometimes the lowest order stage counts by a factor of two rather than ten. This is done whenever the least significant digit is displayed as ZERO and FIVE rather than ZERO through NINE.

The Display Tube Driver Circuits decode the binary coded decimal outputs from each counter stage to signals which drive the appropriate numerical of each Numerical Indicator Tube.

Power Supply

The power supply receives 115 VAC input power and supplies regulated 4.8 volts to counter logic circuits and encoders. Non-regulated high voltage at +175 volts is supplied to the Numerical Indicator Tubes.

English/Metric Scaler P.C. Card

The English/Metric function is optional on the '500' Display Unit. A P.C. scaler card is plugged into the appropriate

connector on the Power Supply P.C. card. In addition, each axis counter/display P.C. card is modified for switching of the decimal point location, and for variation of count factor in the quadrature detection circuits. This switching occurs automatically with change of scale. An additional receptacle is added to the Power Supply P.C. card, and finally the English/Metric selector switch is added to the rear panel.

POWER SUPPLY - REAR PANEL ASSEMBLY

General

The 2588 Power Supply P.C. card serves not only to mount power supply components, but also to provide the inter-connection means for the two plug-in counter-display P.C. cards and the scaler P.C. card when used. Connector receptacles for these plug-in cards and the input connectors are mounted upon the 2588 card.

Control switches mounted on the rear panel control selection of direction, blanking (when used), and English/Metric selection (when used). These switches are wired to points on the 2588 P.C. card.

The 2588 card is mounted to the power transformer, which is mounted on the rear panel. The complete power supply rear panel assembly is removed as a unit from the Display Unit Case.

Circuit Description - (Please refer to #2588 schematic and assembly drawings)

Input power is applied to the primary of the power transformer through the fuse and power switch. The high voltage secondary (red leads) is full-wave rectified by D1 and D2

for power to the nixie tubes, at an unregulated, unfiltered DC voltage of approximately 175 volts average.

The low voltage secondary (green leads) is rectified by the bridge rectifier. The center tap lead is run to the filter capacitor C1 then to the collector lead of the regulator series pass transistor Q1. The negative output of the bridge is connected to circuit ground and the positive output is filtered by C2 then used as the positive supply to the regulator I.C. MFC 4060. The regulator chip output drives the base of the series pass transistor Q1. The output voltage, VCC is regulated at +4.75 volts and is set by means of potentiometer R3.

2939 COUNTER DISPLAY P.C. CARD

General

The 2939 Counter Display provides full electronic circuitry for one axis of position display including polarity, one zero/five stage when used and up to six full decades. Blanking control and direction control functions are operated by external switches. The RESET or ZERO is controlled by a switch mounted on the board, operated from the front panel.

CIRCUIT DESCRIPTION (Please refer to #2939 assembly and 2577 schematic drawings)

1. Quadrature Detection Circuits. A dual channel input amplifier, Q_1 - Q_2 for channel A and Q_3 - Q_4 for channel B, receive the quadrature encoder signals and "clean up" these signals through removal of noise by filtering and by hysteresis of the trigger amplifiers. Dual channel pulse shaping networks Z_1 and Z_2 develop pulses from each edge of incoming signal waveforms, four pulses per input waveform cycle. The next set of gates determines transducer direction with four gates (Z_3 and Z_5) sensing clockwise pulses and four gates (Z_4 and Z_6) sensing counterclockwise pulses. Gate inputs are enabled or disabled by jumpers to determine the count

factor: 1, 2, or 4 pulses per cycle. The CW and CCW pulses are routed through the external direction switch S_1 , then sent to the polarity control logic.

2. Polarity Control Logic. The sign determining logic consists of two gates of Z_5 , Z_6 , Z_7 , Z_8 , and one inverter of Z_{10} . The UP and DOWN pulses from the switch S_1 are inverted by the two Z_5 gates and then presented to the subsequent gates. The Z_6 gates pass UP pulses to the counter, and two Z_7 gates pass DOWN pulses. Z_8 gates form the sign memory latch and its input gates. The sign latch outputs control the polarity tube display drivers. Gates Z_{25} , Z_{26} , Z_{27} , and one inverter of Z_{10} sense the states of the counter stages for the ZERO condition, which is used for control of the polarity gates and latch, changing the sign when passing through ZERO, and passing appropriate UP and DOWN pulses to the bi-directional counter stages.

3. Bi-directional Counter Stages. Seven cascaded counter stages are provided, with the least significant stage counting ZERO and FIVE, and formed by the flip-flop Z_{12} . UP and DOWN pulses are gated by the flip-flop through two inverters of Z_{10} and two gates of Z_9 . The input gate Z_{11} is used as an output buffer amplifier and the other two gates are used as

offset control gates for the flip-flop. UP and DOWN pulse lines are cascaded from output to input of the remaining six decade counter stages Z_{19} through Z_{24} . The counters are reset to ZERO by means of the push-button switch S_3 . Output lines from each counter stage are routed to an output connector J_1 and also to the display drivers and display tube section.

4. Display Drivers and Display Tube Section. The ZERO/FIVE display tube V_7 is driven by Q_6 and Q_7 (ZERO and FIVE). The polarity tube V_8 is driven by Q_8 and Q_9 (PLUS and MINUS). The remaining tubes V_1 through V_6 are each driven by the decoder-driver circuits, Z_{13} through Z_{18} . The three least significant digits are extinguished (blanked out) by the driver Q_5 which is driven by the blanking latch formed by two gates of Z_9 , through the external blanking switch SW_2 and an inverter of Z_{10} . CW pulses set the blanking latch to one state and CCW pulses set to the other state. The center off control switch selects the direction in which the display is blanked, or disables the function.

2749 ENGLISH TO METRIC P.C. CARD

General

The 2749 Scaler P.C. operates in conjunction with the 2939 Counter Display P.C. Card to provide for the electronic scaling of the pulse train to provide Metric unit readout from English unit input signals. Either English or Metric readout is displayed as controlled by the rear panel selection switch. The scaler circuitry is interposed in the pulse logic between the quadrature detection logic circuits and the polarity selection circuits of the 2939 Counter Display P.C. Card. The scaler electronically scales the pulse train to the proper count for the readout.

Circuit Description - (Please refer to #2749 schematic and assembly drawings.)

Two identical circuits, one for each axis, are contained on the board. The scaler circuit is functionally in series with the pulse lines from the quadrature detection logic of the 2939 Card and its direction switch. The input UP and DOWN pulses drive the two cascaded decade counter stages Z_6 and Z_8 . The BCD outputs of these counters are decoded by the two 4 to 10 line decoders Z_7 and Z_9 . The decoded output states drive gates Z_1 , Z_3 , Z_4 , and Z_5 to operate the delayed

pulse networks formed by Z_2 , Z_3 , Z_5 , and C , C_3 , C_4 , and C_5 . At the appropriate times, additional delayed pulses are generated and added to the output pulse stream along with the original input pulse stream. The delayed pulse generators are controlled by the ENGLISH/METRIC control input; 0 volts for English inhibits the delayed pulse generators, and 5 volts for Metric enables them.

A total of 27 additional pulses are generated for each 100 input pulses, forming an exact Metric to English scaling factor of 127: 100.

FIELD SERVICING

Maintenance or servicing of the Microcode System is limited to replacement of an electronics 'tray' or power supply within the Display Unit. The Encoder Assemblies are not field repairable, and must be returned to the factory for service. A loan unit is provided under these circumstances.

A failure in either axis is quickly determined by recognizing a defect in an indicator tube. A tube may exhibit double numbers, may not count properly, or may not transfer count to the next tube properly.

If an Encoder Assembly is suspected, reverse the cables and check to see if the trouble "follows" the encoder and appears in the other axis.

A failure in the power supply can result in the numbers being extinguished in both axes. Check the fuse first to be sure it has not blown. If a new fuse blows a defect in the power supply exists. In other situations, both axes may count improperly, indicating a fault in the power supply voltage regulator.

The following procedure describes the method for removing and replacing any one of the three component parts of the Display Unit.

- a) Remove the six screws on the rear panel. Grasp the two handles and gently withdraw the assembly. CAUTION: Be sure the unit is on a table. An individual tray can easily unplug and fall to the floor. (Fig.#1)
- b) The Display Unit assembly appears as shown in Figure #2. The trays are not supported outside of the case, hence careful handling is mandatory.
- c) A tray may be unplugged by grasping the tray from the right and gently pulling it from the vertical power supply board. (Fig. #3)
- d) The three component parts of the Microcode Display Unit are the power supply and two identical electronic trays. CAUTION: Be sure to keep the defective component marked and separated from the functional unit. Please indicate on a card the nature of the observed defect. (fig. #4)

Re-assembly

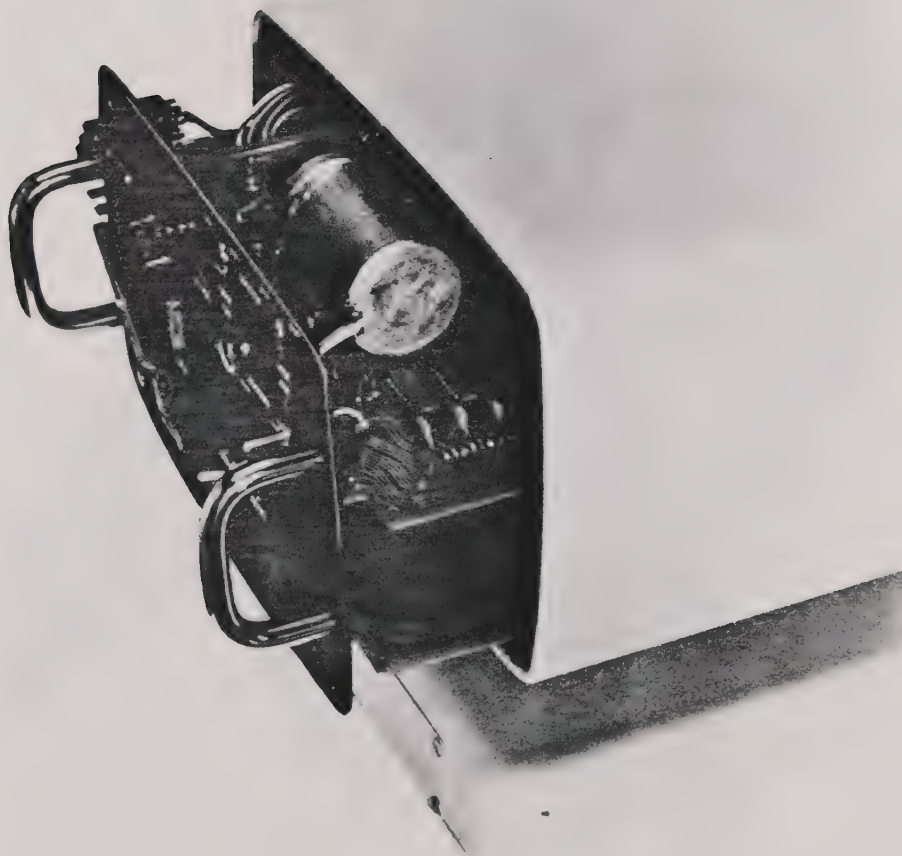
Replug the counter/display P.C. cards into their appropriate connectors on the power supply board. Insert the re-assembled unit carefully in the guide rails provided inside the Display Unit housing. Slide the unit in, making sure that the reset

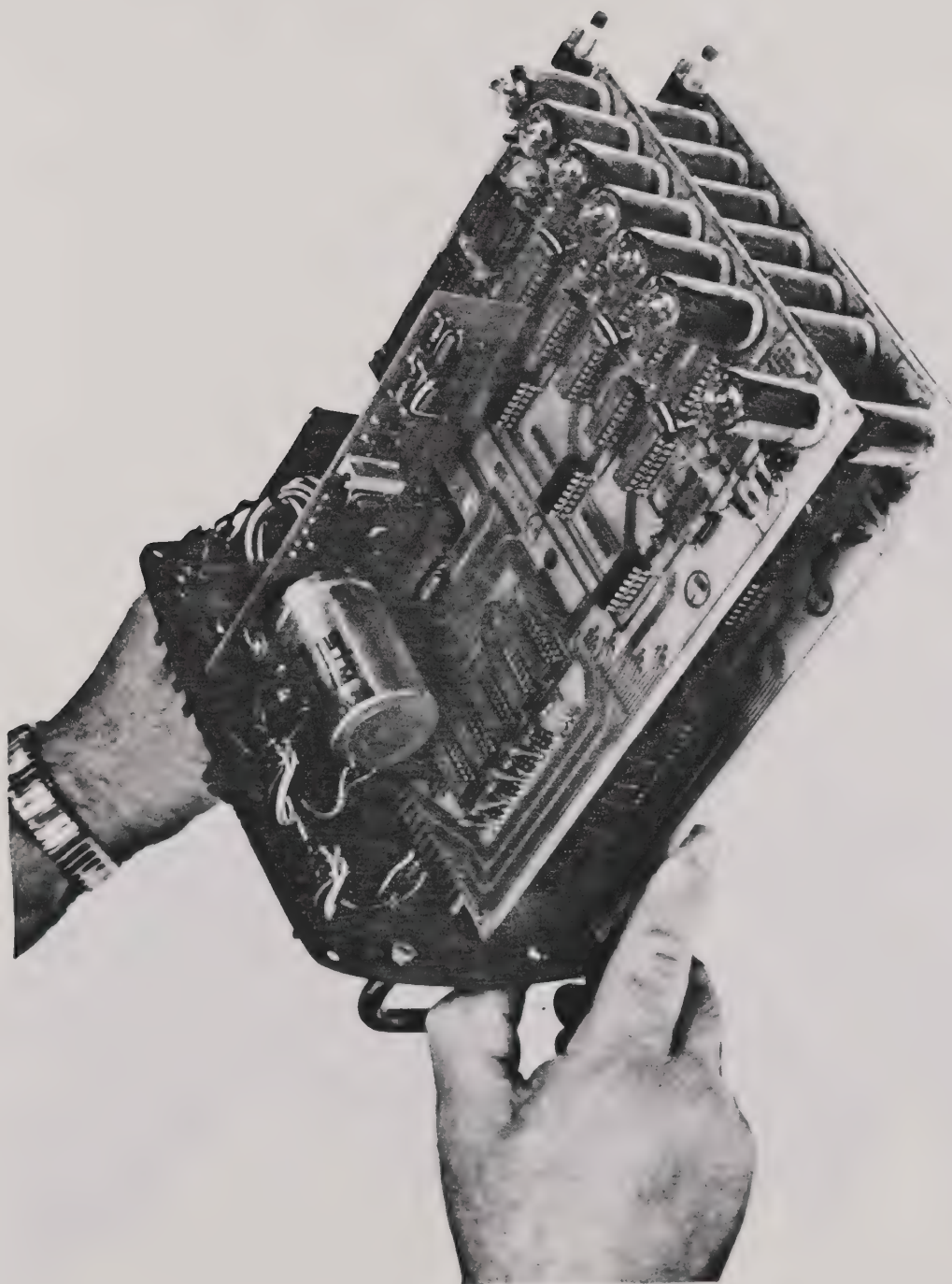
controls seat properly in the rubber boots at the front.
Seat all rear panel screws.

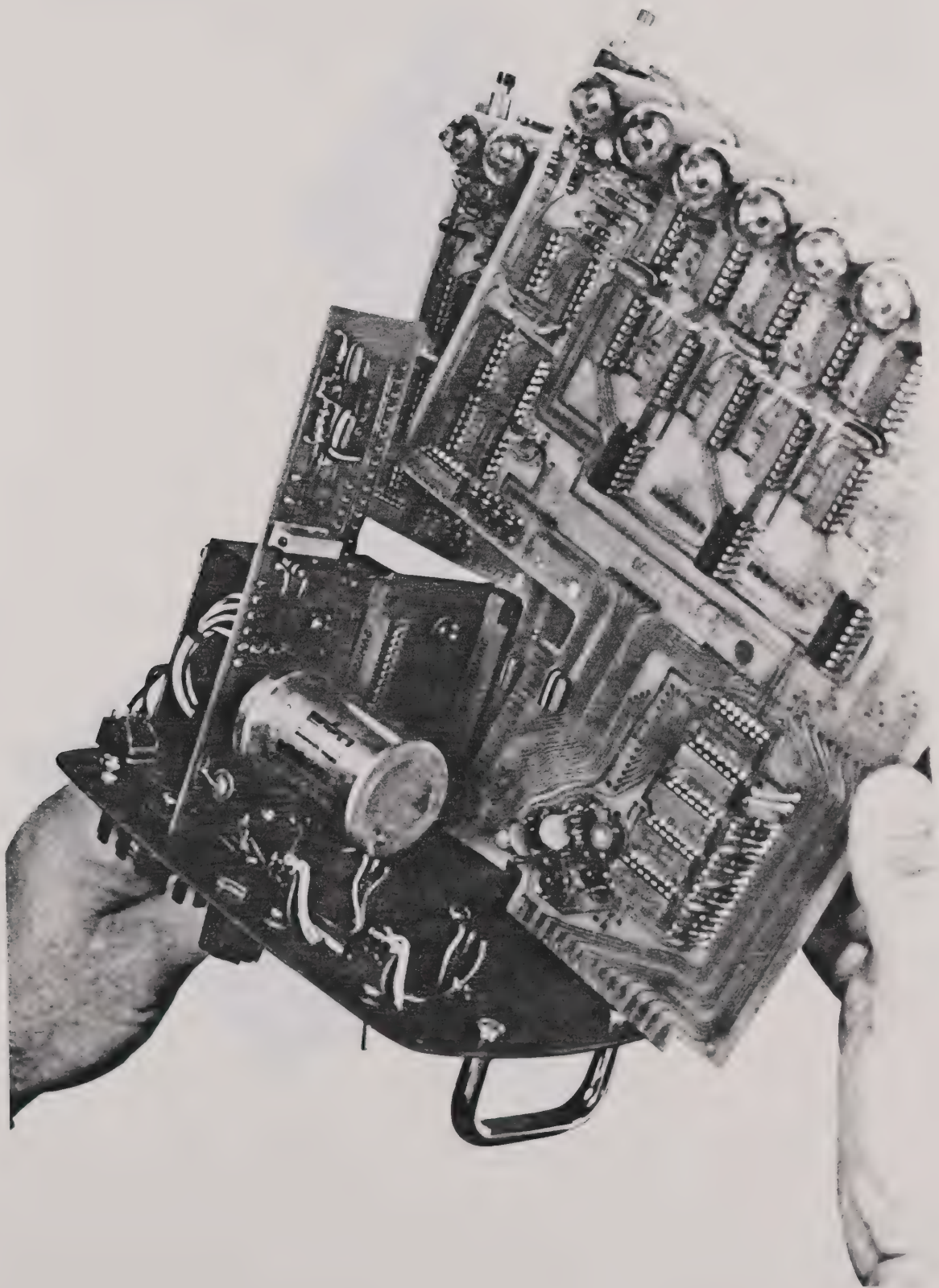
Return of Parts

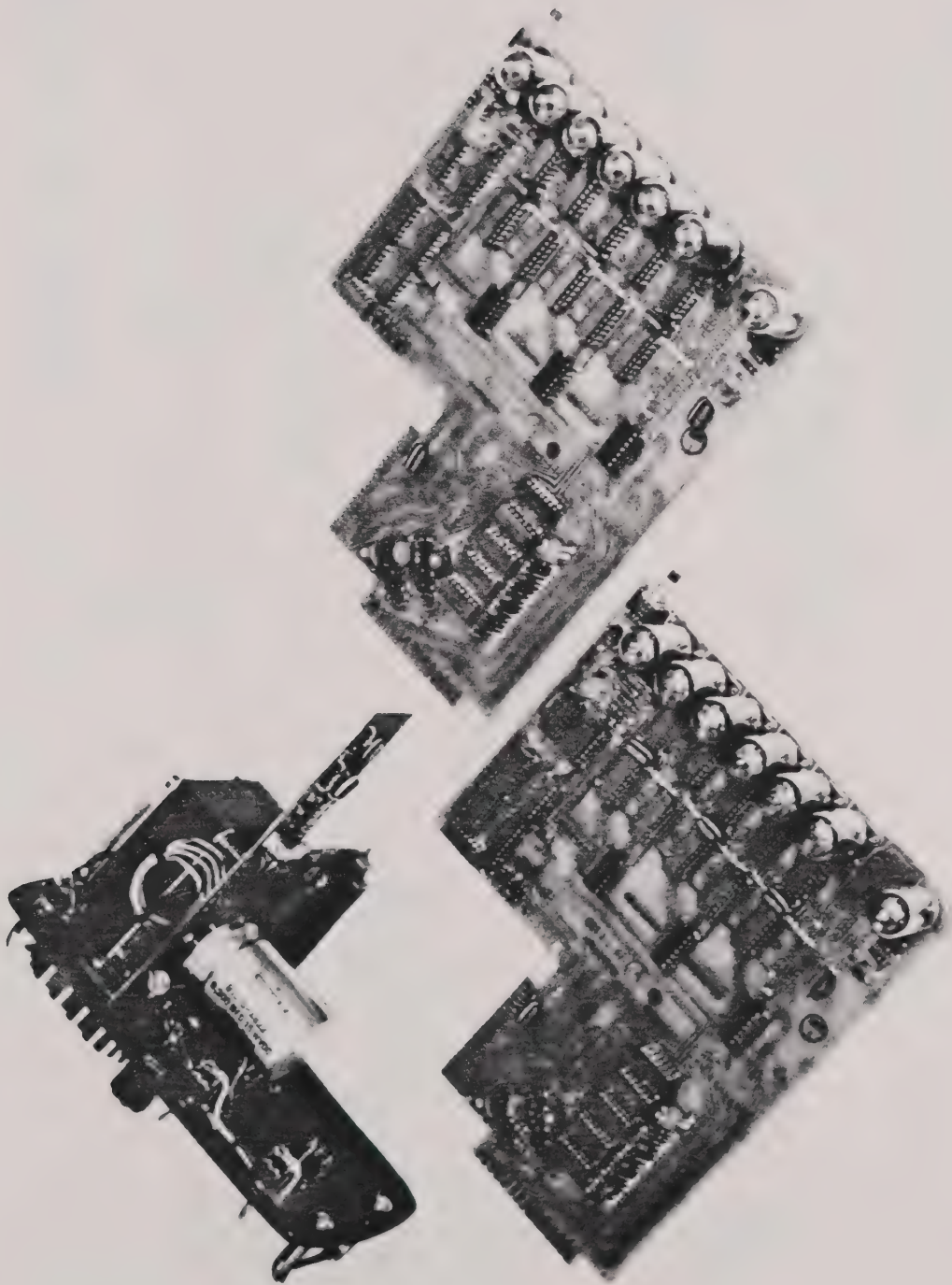
The defective component must be very carefully packed for return to the factory. Use the same shipping container in which the replacement part was shipped. Use a shipping document under which the return is made for proper accountability and identification.

A nominal charge will apply on out of warranty work performed. This charge will be estimated, after examination of the defective component and determination of the extent of repair.

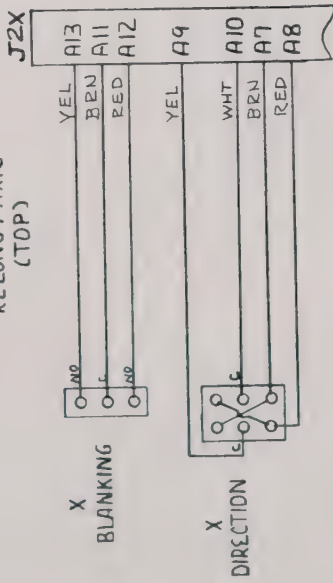




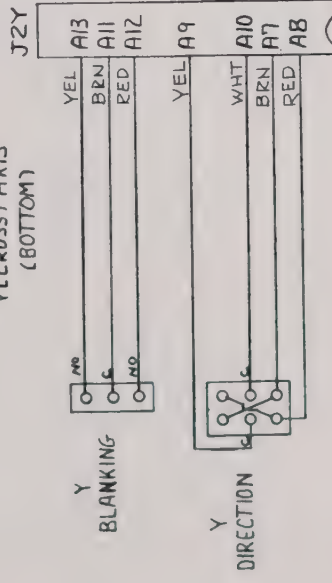




X (LONG) AXIS
(TOP)



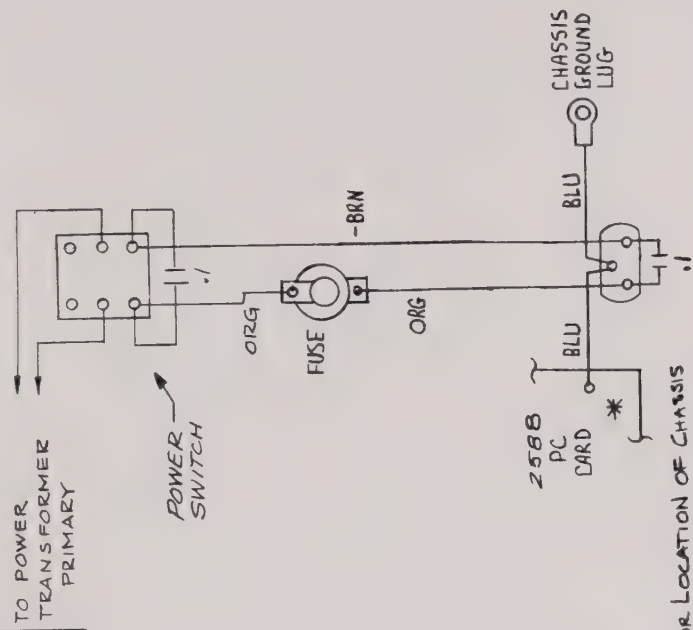
Y (CROSS) AXIS
(BOTTOM)



SWITCH WIRING

CONNECTIONS
ON 258B

B2727



* FOR LOCATION OF CHASSIS
GROUND CONNECTION, SEE
ASSY DWG OF 258B FOR
SPECIFIC INSTRUCTION.

CHG	DESCRIPTION	DATE	DFT	ENG
A	GENERAL CHGS.	12-10-71	TF	

DR	SPJ	DATE	6/24/71	SCALE	N/A
CHK				MAT'L	
ENG	WJK	DATE	12/13/71	FINISH	
TOL EXCEPT AS NOTED					
XX ± .010					
XXX ± .005					
ANG. ± 1/2°					
N/A				2765	
REAR PANEL WIRING				B	2727
TITLE				SIZE	NUMBER
				500	
					REV
					A

WITHOUT
SCALER



CWG	DESCRIPTION	DATE	DFT	EUG.
A	GENERAL CHGS.	12-10-71	TF	

2728

2728

TO TRANS. PRIMARY

POWER SWITCH

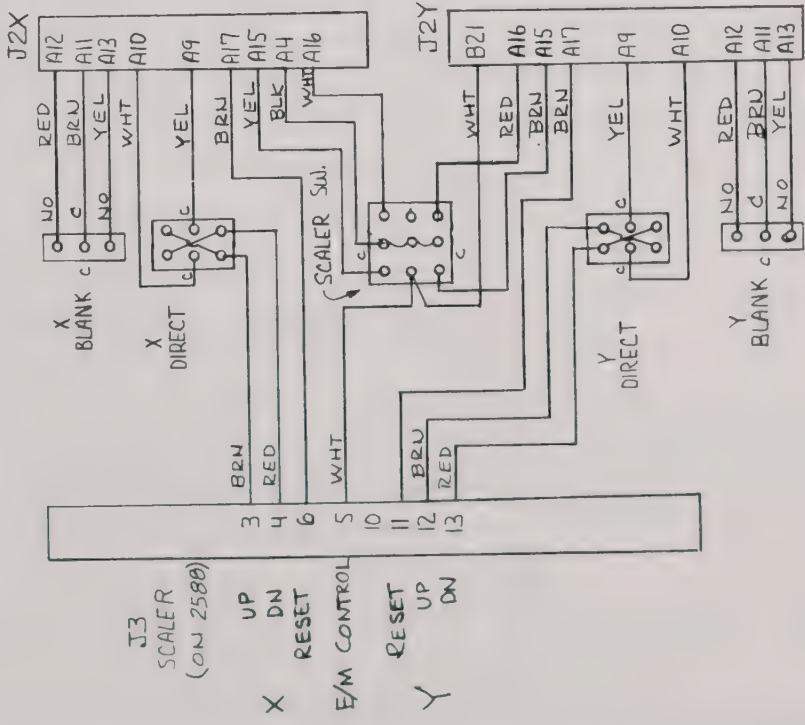
X (LONG) AXIS (TOP)

CONNECTIONS ON 2588

Y (CROSS) AXIS (BOTTOM)

* FOR LOCATION OF CHASSIS GROUND CONNECTION, SEE 2588 ARMY DWG FOR SPECIFIC INSTRUCTION.

2588 ARMY DWG FOR POWER WIRING



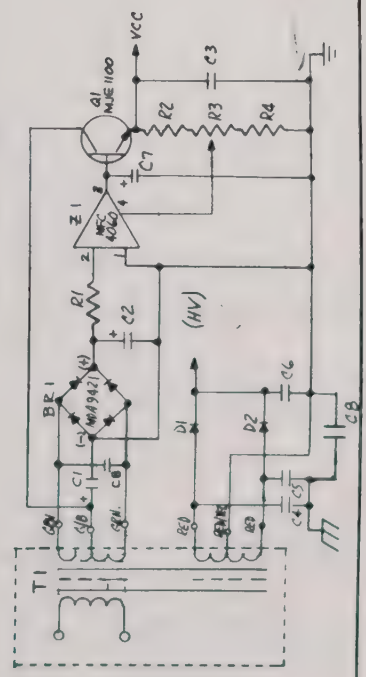
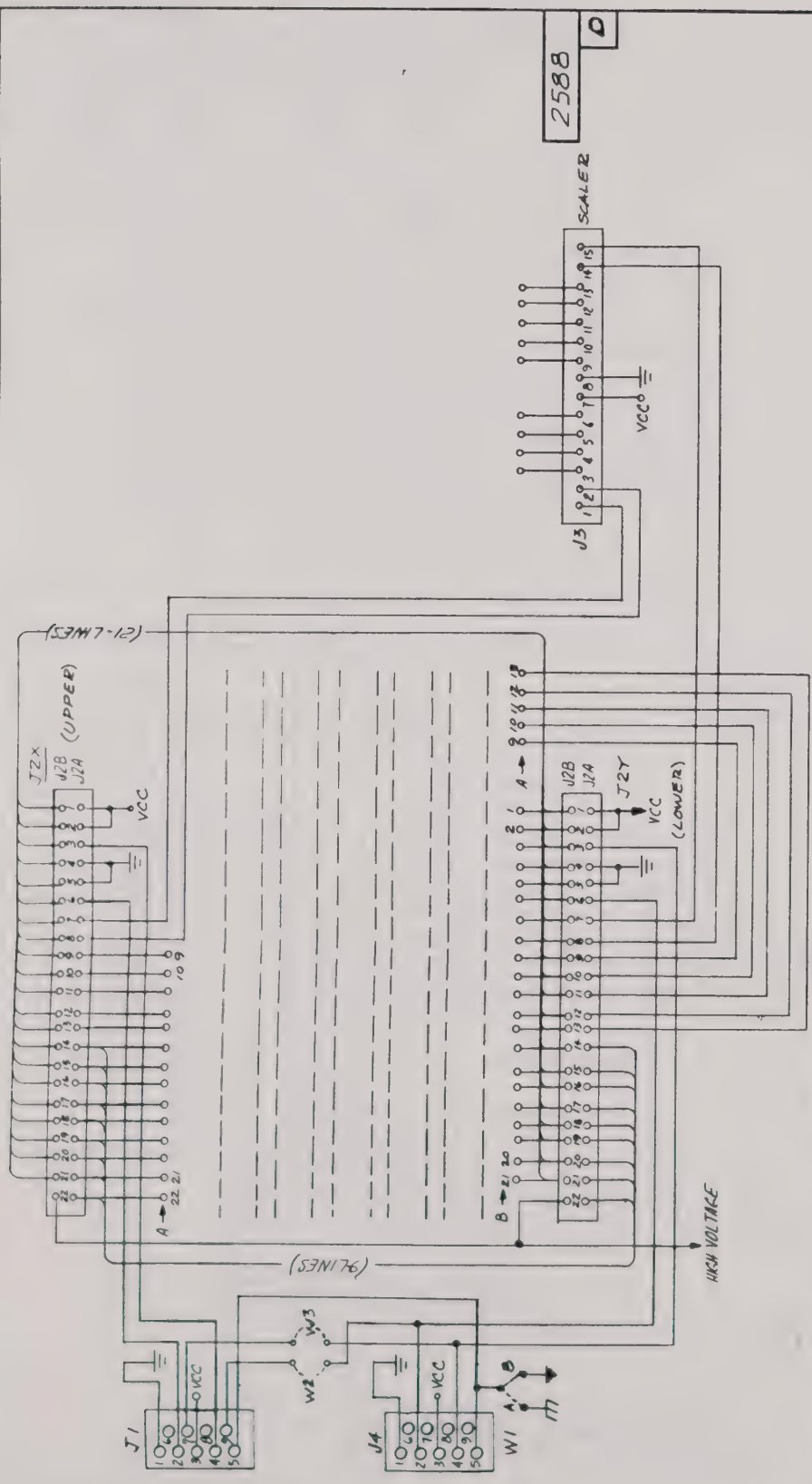
WITH SCALER

DR	SLWT	DATE	6/24/71	SCALE	N/A
CHK				MAT'L	
ENG	WJR	DATE	12/13/71	FINISH	
TOL EXCEPT AS NOTED					
XXX ± .010					
ANG. ± 1/2°					
N.A. 2765					
REAR PANEL WIRING-500					
TITLE				SIZE	NUMBER
				B	2728
				REV	A



ITEM	PART NUMBER	QTY	DESCRIPTION	REMARKS
1	2588	1	P.C. Board, Power Supply, 500	IKL
2	2628B	1	Transformer, Power	IKL
3	C280AEP100K	6	Capacitor, .1 MFD, 250V	Amperex C _{4,5,6,7,8,9}
4	K10C20K	1	Capacitor, 10 MFD, 20V	Kemet C ₃
5	AmperexC-437	1	Capacitor, 250 MFD, 16V	Amperex C ₂
6	91C15HA822	1	Capacitor, 8200 MFD, 15V	STM C ₁
7	Cinch DE-9P	1	Connector, Receptacle	J ₄
8	1N4385	2	Diode, 1A, 600V	Sylvania D _{1.2}
9	2VH22/1JV5	2	Connector, Card	Viking J ₂
10	77 PR 500	1	Potentiometer, 500 OHM	Helipot R ₃
11	MDA 942-1	1	Rectifier, Bridge	Motorola
12	MFC 4060	1	Regulator, Voltage	Motorola
13	47 OHM	1	Resistor, 10%, 1/4W	R ₂
14	1K	1	" " "	R ₁
15	1.5K	1	" " "	R ₄
16	C8906-832-4	1	Nut, Speed, Right Angle	Tinnerman
17	8-32 x 1/4"	3	Screw, Fillister Head, Phillips	
18	Alpha 5855		Wire, Brown	
			Grey	
			Red	
			Yellow	
			USE FOR DASH 2 ASSEMBLY ONLY	
19	SAC15s/2-2	1	Connector, Card	SAE Advanced Packaging

DR <i>JS</i>	DATE 6-22-72	SCALE	 INCORPORATED NEWPORT BEACH, CALIFORNIA
CHK		MAT L	
ENG			
TOL EXCEPT AS NOTED		FINISH	
XX ± .010	XXX ± .005	ANG ± .125	
P.C. Board, Power Supply, 500 Display A			2588-1 & -2
TITLE			REV



ITEM	REV. NO.	REV. DATE	REV. DESCRIPTION	REVISIONS	DATE	BY	CHKD.
1	1	1-71	SCALE				
2	2	1-71	SCALE				
3	3	1-71	SCALE				
4	4	1-71	SCALE				
5	5	1-71	SCALE				
6	6	1-71	SCALE				
7	7	1-71	SCALE				
8	8	1-71	SCALE				
9	9	1-71	SCALE				
10	10	1-71	SCALE				
11	11	1-71	SCALE				
12	12	1-71	SCALE				
13	13	1-71	SCALE				
14	14	1-71	SCALE				
15	15	1-71	SCALE				
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100	100	1-71	SCALE				

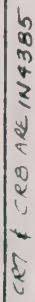
2 of 3

ITEM	PART NUMBER	QTY	DESCRIPTION	REMARKS
1	2577F	1	P.C. BOARD	IKL
2	SN74192	5	I.C. (DM8560)	Z ₁₉₋₂₃
3	SN7441AN	5	I.C.	Z ₁₃₋₁₇
4	MC1810P	3	I.C.	Z ₂₅₋₂₇
5	DM936P	3	I.C.	Z _{1,2,10}
6	DM962P	3	I.C.	Z _{3,4,7}
7	DM946P	5	I.C.	Z _{5,6,8,9,11}
8	DM945P	1	I.C.	Z ₁₂
9	ZM1000	5	TUBE, DISPLAY, AMPEREX	V ₂₋₆
10	ZM1001	1	TUBE, DISPLAY, AMPEREX	V ₈
11	P8121R-2	1	SWITCH, PUSH BUTTON	SW ₃
12	2N5133	2	TRANSISTOR	Q _{8,9}
13	1936-4-7	30	I.C. SOCKET TERMINAL, MOLEX	Z _{1,-Z₁₂, Z₁₈, Z₂₄₋₂₇}
14	1938-4-8	20	I.C. SOCKET TERMINAL, MOLEX	Z _{13-Z₁₇, Z_{19-Z₂₃}}
15	D9913-11	7	DIODE	CR _{1-4,7}
16	5GA-D10	7	CAPACITOR, SPRAGUE, 1000pf	C _{1-4,9-10}
17	2N5134	4	TRANSISTOR	Q ₁₋₄
18	C230AEP100K	5	CAPACITOR, AMPEREX, .1mf	C ₁₂₋₁₅
19	3339-H-1-501	2	POTENTIOMETER, BOURNS	R ₄₇₋₄₈
20	5GA-D50	2	CAPACITOR, SPRAGUE, 1000pf	C _{5,7}
21	68 OHMS	2	RESISTOR, 1/4W, 10%	R _{49,50}
22	100 OHMS	2	" " "	R _{6,12}
23	1K OHMS	12	" " "	R _{5,11,21,25,37,40,41,43,53}
24	2.2K OHMS	6	" " "	R _{1,2,7,8}

DR T.F. 042-10-71		SCALE		 INCORPORATED NEWPORT BEACH, CALIFORNIA	
CHK		MAT'L			
ENG <i>6-22-72</i>		FINISH			
TOL EXCEPT AS NOTED XX ±.010 XXX -.005 ANG -.125"					
P.C. BOARD, 500, COUNTER DISPLAY				A	2939-0
TITLE PG. 1 of 2				SIZE	NUMBER REV

DR <i>98</i>	DATE <i>6-22-72</i>	SCALE	 ITEK INCORPORATED NEWPORT BEACH, CALIFORNIA	
CHK		MAT'L		
ENG				
TOL EXCEPT AS NOTED		FINISH		
XX .010 XXX .005 ANG .125				
P. C. BOARD, 500, COUNTER DISPLAY			2939-0	
TITLE <i>PG.2 of 2</i>			SIZE	NUMBER
				REV

2939-2



1. FOR x_1 USE w_1 , w_2 , w_3

NOTE:

(SCALER MODIFICATION) 525.5 (.0005)

[illegible]

X-AXIS (UPPER)

C1, C3 - .001 uf
C4, C5 - .01 uf
C2 - .1 uf

R1, R4 - 1.0K
R2, R5 - 5.6K
R3, R6 - 3.3K

2749

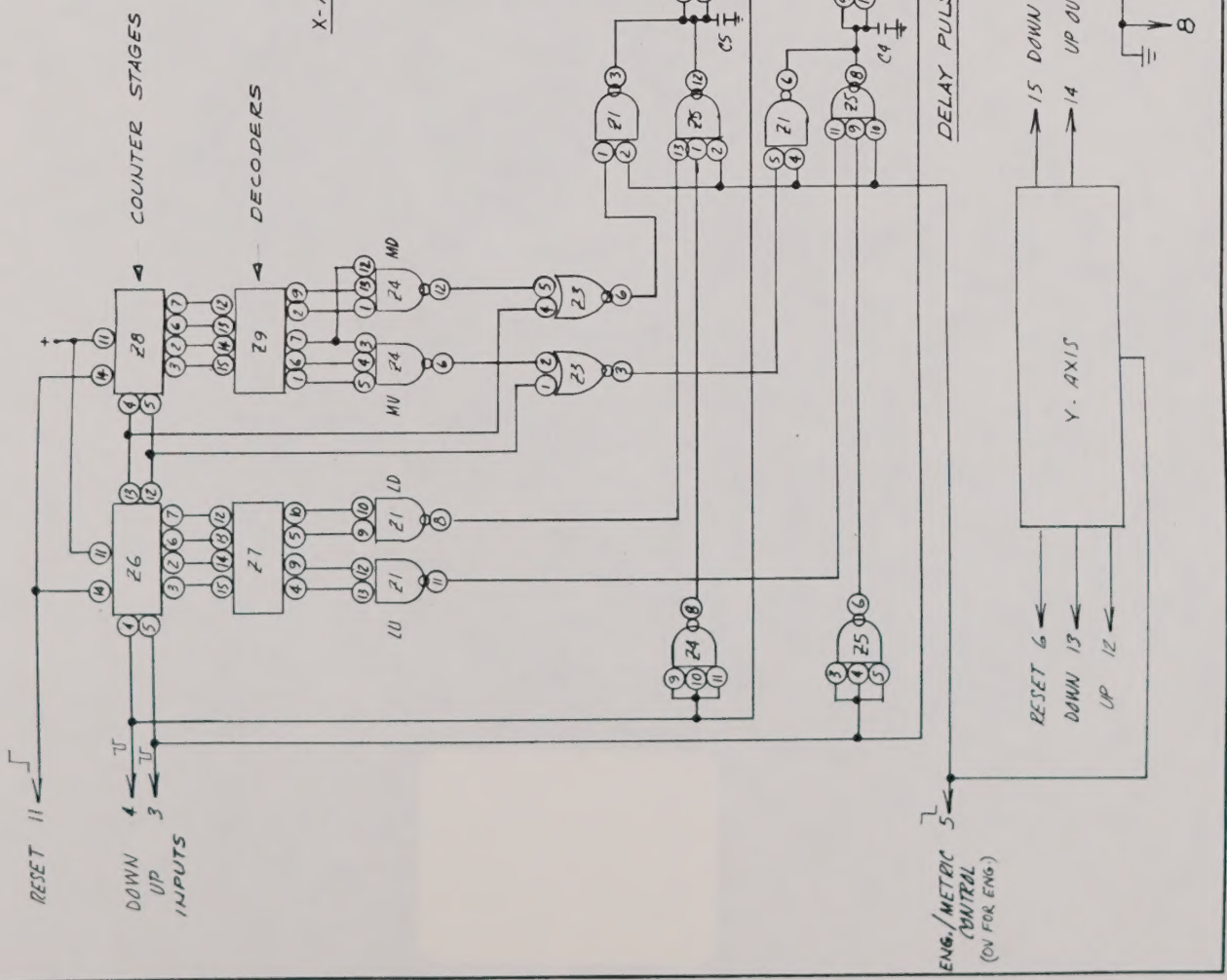
A

- 1 AS SHOWN
- 2 ELIMINATE "Y" AXIS ICS.

FORM	PART NO.	NO. REV'D	PART DESCRIPTION	MATERIAL SPEC.	TEST MATH.
	WJF	DATE 8-71	SCALE 2X		
DWG			MAT'L SEE L/H		
SHEET 2 OF 2	WORK 12-14-71		FINISH		
TOL EXCEPT AS NOTED 1/8" ± 1/16" ± HOLE DIA. .005" ±					
				INCORPORATED	
					
				NEWPORT BEACH, CALIFORNIA	
ASSY-(X-Y) AXIS SCALER				C	A
				SIZE	HANDS
					BAL.

- 21, 22 - 946
- 23 - 1810
- 24, 25 - 962
- 26, 28 - 8560
- 27, 29 - 8842

- C1, C3 - .01 μ f
- C4, C5 - .01 μ f
- C2 - .1 μ f
- R2, R5 - 5.6K
- R3, R6 - 3.3K
- R1, R4 - 1.0K



X-AXIS

2749 A

ITEM	PART NO.	NO. REV'D	DATE	SCALE	PART DESCRIPTION	MATERIAL SPEC.	TEST AMT.
ONE	2749	8/71	12/14/71	1/16"	INCORPORATED		
TITLE: ENG-MET. CONV. SCHEMATIC C							
REV. 1							
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REV. 98							
REV. 99							
REV. 100							

MP MASTER



MA32031